REMARKS

Claims 1-18 currently are pending. By way of the present response, claims 1, 5, 9, 10, 16 and 17 are amended. Reconsideration and withdrawal of the rejection of the claims is respectfully requested in view of the above amendments and the remarks advanced below.

Starting on page 2 of the Action, claim 5 is rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. More particularly, the Examiner asserts that it is not clear which of the first and second visibility tests set forth in claim 1 is referred to by the term "visibility test" recited in claim 5. In response, claim 5 is amended to include "first" before "visibility test." Support for this amendment is found at least in original claim 5. It respectfully submitted that the present amendment obviates the Section 112 rejection.

Pages 2 to 3 also include a rejection of claims 1-18 under 35 U.S.C. § 101, as allegedly being directed to non-statutory subject matter. With respect to the subject matter recited in claims 1-8, the Examiner alleges the claims "appear to be an abstract idea rather than a practical application of the idea" (see, page 2, line 1 of section 5). The Examiner goes on to make the following statements:

1) "The claimed invention does not result in a physical transformation ..." (section 5, line 2).
2) "[N]or does the claimed invention appear to provide a useful, concrete and tangible result" (section 5 lines 2-3).
3) "Claims 1-8 are directed to a process that does nothing more than solve a mathematical problem and manipulate abstract ideas ..." (section 5, lines 3-4).
4) "Claims 1-8 are directed to a process consisting solely of operations manipulating a set of mathematical entities. The result of the operations is set numbers representing intensity values arranged as a two-dimensional array." (See, section 7, lines 1-3.)
5) "It fails to use the result of 'rasterizing visible primitives' to enable its functionality to be realized." (Section 7, lines 3-4.)
6) "Additionally, the asserted practical application in the specification of method for testing visibility is "displaying the rasterized visible primitives." The practical application is not recited in the claims nor does it flow inherently therefrom." (Section 7, lines 4-6.)

Applicant respectfully traverses these statements, for the following reasons:

With particular reference to the second though fourth statements, above, Applicant

submits that each of claims 1-8, when considered as a whole, do not merely represent a disembodied mathematical concept or truth that is not useful. Rather, the claimed invention provides a useful, concrete and tangible result. More particularly, the claimed method includes *inter alia* first and second visibility tests that operate to reduce the number of hidden primitives sent to the rasterizer, and thus reduce demand on the rasterizer's complex and computationally demanding operation. The claimed combinations of steps including first and second visibility tests, and the resulting rasterized visible primitives can save a significant amount of computing time. This is a particularly useful and tangible result, for example, in situations where graphics processing involves a large amount of graphics primitives or where computing capacity is low. (See, page 4, lines 11-17 and page 9, lines 30-32.)

In the paragraph spanning pages 2 to 3 of the Action, the Examiner relies on *Gottschalk, Comr. Pats. v. Benson et al.*, 175 USPQ 676, which held that claims reciting a mathematical formula for converting binary coded decimal numbers into to pure binary numbers did not constitute patentable subject matter under 35 U.S.C. 101 because "[t]he mathematical formula involved here has no substantial practical application except in connection with a digital computer, which means that if the judgment below is affirmed, the patent would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself." *Id.*

However, the decision in *AT&T Corp. v. Excel Communications*, 50 USPQ2d 1452 explains that in *Diamond v. Diehr,* 450 U.S. 175, 182 [209 USPQ 1] (1981), the Supreme Court "expressly limited its two earlier decisions in *Flook* and *Benson* by emphasizing that these cases did no more than confirm the 'long-established principle' that laws of nature, natural phenomena, and abstract ideas are excluded from patent protection." 450 U.S. at 185. *AT&T* further explained that while AT&T was impliedly using something based on simple Boolean algebra in order to determine the value of a PIC indicator, "AT&T did not claim the Boolean principle as such or attempt to forestall its use in any other application ... The PIC indicator represents information about the call recipient's PIC, a useful, non-abstract result that facilitates differential billing of long-distance calls made by an IXC's subscriber. Because the claimed process applies the Boolean principle to produce a useful, concrete, tangible result without pre-empting other uses of the mathematical principle, on its face the

claimed process comfortably falls within the scope of Section 101." Analogously, while the present invention utilizes a set of mathematical principles to determine visibility of graphics primitives and a resulting set of rasterized primitives, the resulting rasterized data set is not abstract because it has real world value in applications involving computer graphics (e.g., computer games). As the Examiner appears to appreciate, a result of the processes of claims 1-8 can be a set of numbers representing intensity values arranged as a two-dimensional array (see, page 3, lines 7-8). Such a data set represents pixel levels on a screen to be displayed, which is a useful and tangible result in connection with processing three-dimensional computer graphics to be rendered in a screen. See also, the Federal Circuit's holding in *In re Alappat*, USPQ2d 1557 regarding claims directed to data transformed by mathematical calculations in a rasterizer to produce data to be displayed as being "a useful, concrete, and tangible result."

On page 3 of the Action, the Examiner states, "the asserted practical application in the specification of method for testing visibility is 'displaying the rasterized visible primitives.'" While Applicants agree that displaying visible primitives certainly would be *one* practical application of the claimed invention, another practical application would be occluding non-visible graphics primitives to efficiently rasterized only visible graphics primitives to be rendered. (See, for example, lines 10-15 of page 3 and lines 11-15 of page 4.)

With respect to the first statement, above, alleging that the claimed invention does not result in a physical transformation, the Examiner appears to assert that physical transformation would be necessary for process claims to recite patent-eligible subject matter. However, as explained in *AT&T Corp. v. Excel Communications*, 50 USPQ2d 1452, "The notion of "physical transformation" ... is not an invariable requirement, but merely one example of how a mathematical algorithm may bring about a useful application." As pointed out above, the claimed invention can perform efficient occlusion culling of a large set of graphics primitives to remove primitives hidden in a scene before rasterization to save computing time spent on rasterization, which is a useful, tangible result.

Finally, in the above fifth statement, the Examiner appears to require some function to be recited for the step of rasterizing visible primitives. It is believed those of ordinary skill in

the art would understand what "functionality" would be involved with rasterization, especially when reading this claimed feature in light of the specification. In any event, to address the Examiner's concerns, claim 1 is amended to further clarify the function of the step of "rasterizing visible primitives of the second visibility test" is "to produce a screen of the scene to be rendered." This feature is supported by the original disclosure, for example, at page 7, lines 20-23 and page 9, lines 30-36. If, in the next official communication to Applicant, the Examiner persists in maintaining this requirement related to "functionality," he is requested to explain in detail what additional "enablement" would be required, along with supporting authority, in connection with 35 U.S.C. 101.

With respect to claims 9-18, the Examiner asserts that these claims are directed to a generic computing system performing a mathematical algorithm without a recited practical application. Applicant disagrees that claims 9-18 were directed to non-statutory subject matter. For instance, claim 9 falls into the statutory category of a machine including, among other things, a geometry processor, which is a real thing and not some abstract concept or idea. In addition, claim 9 is amended to recite interrelated operative language for the claimed elements of the system. The claimed combination of elements as a whole form a machine for converting scenes that may, foe example, include a large number (e.g., thousands or millions) of graphics primitives to a form to be rendered on a screen. As pointed out above, the claimed first and second visibility tests operate to reduce the number of hidden primitives sent to the rasterizer, and thus reduce demand on the rasterizer's complex and computationally demanding operation. This is not a disembodied mathematical concept, but rather a specific machine including elements operative to produce a useful, concrete, and tangible result.

For at least these reasons, each of claims 1 and 9, and the claims depending therefrom, cannot be viewed as simply reciting an abstract idea in the form of mathematical algorithms because the elements of the invention operate to produce a useful, concrete, and tangible result. Accordingly, Applicant respectfully requests withdrawal of the Section 101 rejection.

Turning now to the rejections based on prior art, pages 4 to 8 include a rejection of claims 1, 2, 4, 5, 7 and 8 under 35 U.S.C. § 102(e) as allegedly being anticipated by Greene et

al. (U.S. Patent No. 6,480,205); pages 9-12 include a rejection of claims 3, 9-12 and 14-18 under 35 U.S.C. § 103 as allegedly being obvious over Greene et al. in view of Schaufler et al. (G. Schaufler et al., "Conservative Volumetric Visibility with Occluder Fusion," Proc. of the 27th Annual Conf. On Computer Graphics and Interactive Techniques, July 2000, pp. 229-238); page 13 includes a rejection of claim 6 under 35 U.S.C. § 103 as allegedly being obvious over Greene et al. in view of Fowler et al. (U.S. Patent No. 6,720,964); and pages 13 to 14 include a rejection of claim 13 35 U.S.C. § 103 as allegedly being obvious over Greene et al. in view of Schaufler et al. and Fowler et al. These rejections are respectfully traversed.

Greene discloses Z-buffer rendering of three-dimensional scenes that is made more efficient through a method for occlusion culling by which occluded geometry is removed prior to rasterization. The method uses hierarchical z-buffering to reduce the quantity of image and depth information that needs to be accessed. A separate culling stage in the graphics pipeline culls occluded geometry and passes visible geometry on to a rendering stage. The culling stage maintains its own z-pyramid in which z-values are stored at low precision (e.g., in 8 bits). The efficiency of hierarchical z-buffering is obtained through hierarchical evaluation of line and plane equations.

The claimed invention recites an advanced method for visibility testing before rasterization of a three-dimensional scenes. The claimed subject matter reduces the number of the polygons to be rasterized as the rasterization requires computation power. Thus, if a polygon is not visible in the end result it would be beneficial to avoid the rasterization. However, complete visibility testing is a difficult task and typically computer graphics systems rasterize at least some polygons that are not visible in the result picture. Thus, better visibility tests are required for improving the graphics quality.

The object of the solution disclosed by Greene is practically the same. Greene uses Z-buffer based visibility test to which it is possible to combine different visibility tests, such as bounding box. Before the visibility test, a culling stage is implemented for producing culling information. The culling stage uses Z-pyramid that has low precision, such as eight bits, Z-values. The visibility test in Greene is a conventional high precision Z-buffer, where in the precision of the Z-values is 32 bits.

Even if the solution disclosed by Greene is able to provide high quality graphics, it has a major drawback of requiring a lot of processor and memory resources.

In contrast, the claimed invention provides high quality computer graphics with lower resource requirements.

The first significant difference of the present invention and solution disclosed by Greene is that in Greene a full precision Z-buffer is required. The claimed invention does not need a full precision Z-buffer. However, in order to provide the same quality as Greene, two separate visibility tests are required in addition to the culling stage.

In the present invention, the first visibility test, such as a low precision Z-buffer is performed before the culling stage. In Greene, there is no mention of visibility tests before the culling stage. The benefit of the first visibility test is that it is possible to reduce the number of the polygons to be processed in the culling stage as the occlusion data is computed only for polygons that are visible in the first visibility test at the moment they are tested. It is important to understand that it is possible that the first visibility test classifies the polygon to be visible if it is visible at the moment of the testing even if it will be occluded later when further polygons are tested. However, if a polygon is not visible in the first test, it can be excluded in the early stage.

After the culling stage, there is a visibility test in the both solutions. However, in Greene, this visibility test is a high precision Z-buffer with possible further visibility tests, such as a bounding box. In the claimed invention, the second visibility test is typically similar to the first one. As the polygons are already tested and the occlusion data is computed, with occlusion data the second test is able to provide good results even if it is similar to the first test. Thus, also the second visibility test may be a low precision Z-buffer. However, it is not necessary that the first and the second visibility test are similar to each other. This is a significantly simpler solution that does not require high precision hardware that is expensive to implement. However, even if the claimed invention is reduced in complexity, it is able to provide high quality graphics. In addition to the reduced complexity, the claimed invention also reduces computing power and memory requirements.

Thus, the claimed invention is significantly different to the solution disclosed by Greene.

Additionally, the further cited documents to Fowler and Schaufler do not suggest a solution, wherein there are separate visibility tests before and after the culling stage. Thus, there is no suggestion of the claimed method and system in these documents. Accordingly, Applicants consider the claimed invention not only novel, but also significantly different from those disclosed in the cited prior art.

Based on the foregoing, Applicants respectfully request that the pending rejections based on Sections 101, 112, 102 and 103 be withdrawn, and the application passed to issuance. Prompt notification of the same is earnestly sought.

Respectfully submitted,

/John F. Guay, Reg.# 47248/
John F. Guay

Nixon Peabody LLP
401 9th Street N.W.
Suite 900
Washington, D.C. 20004
(202) 585-8000